# DAM SAFETY SECTION
## CRITICAL INFRASTRUCTURE DIVISION

**Dam Safety Inspection Report**

## GENERAL INFORMATION

INVENTORY NO.: TX03755

DAM: LAKE CHARMAINE DAM

OWNER: CITY OF IVANHOE

STREAM: MAGNUS BRANCH

BASIN: NECHES RIVER BASIN

COUNTY: TYLER

GENERAL LOCATION: 6 MI SOUTH OF WOODVILLE

DAM HEIGHT: 24 FEET

SIZE CLASSIFICATION: SMALL

NORMAL CAPACITY: 608 ac-ft

MAXIMUM CAPACITY: 700 ac-ft

NORMAL WATER LEVEL: 163 ft-msl

CURRENT WATER LEVEL: 163.2 ft-msl

PREVIOUS INSPECTION DATE: 7/18/2012

CURRENT INSPECTION DATE: 6/14/2017

INSPECTION TEAM: Robert Calderon, P.E., and Bill Sweeney, EIT

PERSONNEL CONTACTED: Rusty Harrison (City of Ivanhoe dam supervisor)

## SUMMARY

Lake Charmaine Dam, a small sized earthen dam with a concrete protected crest, upstream, and downstream slope, was inspected by TCEQ Dam Safety staff on June 14, 2017 as part of a scheduled routine safety inspection and was found in poor overall condition. Prior to this inspection the owner performed repair work to bore into the concrete capped downstream slope at several locations and grouted all voids that were found as well as re-sealed all open joints and cracks.



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While an extensive amount of work was completed, there is still evidence that a piping condition with transport of fines is occurring. Therefore, the overall poor rating is appropriate.

The deficiencies noted during this inspection included the following: seepage through cracks along the downstream slope, a boil at the toe of the downstream slope (stilling basin area), cracking and spalling along parts of the concrete slabs near the service spillway, and sediment buildup in the stilling basin. All of the deficiencies noted during this inspection appeared to be at about the same level or slightly less than noted in past inspections. No new deficiencies were noted. Lastly, a revision to the draft is required to finalize and complete the Emergency Action Plan (EAP).

## BACKGROUND

TCEQ Dam Safety records indicate that Lake Charmaine Dam was originally constructed in 1965 as an earthen embankment for recreational purposes. The spillway was overtopped in September of 1996 and the dam failed (The storm was recorded as 16 inches of rainfall in a 24-hour period). The dam was reconstructed in 2003 with the original 36-inch drop structure spillway replaced by a 160-ft wide concrete broad crested weir spillway. Additionally, the embankment, except for short areas at each end, was capped with concrete slabs and is capable of being overtopped (acts as an emergency spillway 900-ft in width). In 2003, immediately after the rebuild, a void was discovered under a section of the concrete spillway slab on the downstream end. This cavity was filled with 15-20 cubic yards of clay and grout. It was stated by the owner that this section of the embankment was part of the original embankment that was not rehabilitated.

TCEQ records indicate that the dam has been inspected by the Texas Dam Safety Program at least 10 times (from July-1983 to July-2012) prior to this current inspection. Throughout the history of the dam there has been evidence of seepage with transport of fines through the structure and with multiple repairs to the spillways and structure. Since the dam breached and was reconstructed in 2004, the primary deficiencies included: seepage below the low-flow outlet and through cracks and open joints in the downstream slabs, sediment buildup from associated boils at the toe of the downstream slope (stilling basin area), spalls and cracks in the slab sections near the service spillway, and clogged weep holes. The dam was last rated (July 2012) in poor overall condition.

The history of the dam and last inspection (poor overall rating) suggests that a piping condition with sediment transport is occurring. This was reinforced from self-inspections the City has continually conducted after the 2012 inspection. Those self-inspections identified large voids beneath the downstream concrete slabs, active sand boils, and increased movement/separation between the road and upstream slope. Even Dam Safety inspections going back to 2004 and 2007

identified problems with cracking and seepage through the slab, as well as sand boils.

In February of 2014, TCEQ Dam Safety was notified that the City of Ivanhoe hired an engineer (Butch Wilson – LJA Engineering, Inc.) to develop a plan to fill voids under the concrete slabs and then seal the joints to try to prevent migration of water under the slabs and through the embankment. However, this work was completed without submission and approval through the TCEQ Dam Safety construction plan review process as required by 30 TAC §299.22. The rehabilitation work included pumping over 250 cubic yards of flowable fill into bores under the concrete slabs on the downstream side of the embankment. This work went on for several iterations as voids were believed to have been noted at differing times. Additionally, all open joints were sealed with elastic sealant. The owner also indicated that two new boils appeared in November of 2014. These boils stopped flowing after the lake level was lowered below the service spillway lip. Lastly, the City's October 2015 inspection report submitted to TCEQ Dam Safety indicated a 16 cubic yard void beneath the crest of the dam. TCEQ responded and emphasized the serious nature of the problem and that the City needed to secure TCEQ review and approval of any repair work.

## PRE-INSPECTION MEETING

Mr. Harrison was contacted approximately 2 weeks prior to the inspection and in a brief phone call was informed of the nature of the safety inspection. Mr. Harrison met with TCEQ inspectors throughout the inspection and answered all questions, especially as related to the recently completed dam improvements.

## INSPECTION FINDINGS

Figure 1 is a location map of the Lake Charmaine Dam relative to the City of Woodville and the major roadways in the area. Figure 2 is an aerial photo of the dam with elevation contours. Figure 3 is a sketch of the dam indicating photo locations. Lastly, for purposes of clarification, any "Left" and "Right" designations in this report are from the viewpoint of looking downstream of the dam. During this inspection, the water surface was two inches above the spillway (normal pool level).

### Crest

- The dam is 1200 feet long with a crest width (concrete roadway) of approximately 24-ft. The crest was relatively level with no dips or low spots and was found to be in good condition (See Photos 1 and 2).
- Elastic sealant that was noted as missing in some joints from the previous inspection appeared to have been applied everywhere as needed.
- The area of the crest at one of the joints where the 16 cubic yard void was previously detected and was noted to have been filled with flowable fill and

grout (September 2016 – City inspection report) was not observed during this inspection.

## Upstream Slope

- The upstream slope was capped in concrete slabs with a consistent surface estimated at approximately 3 horizontal to 1 vertical (3H:1V) and was found in good overall condition (See Photos 3-7).
- The previous inspection had noted an open joint between the upstream slope and the crest. That joint was filled with sealant during this inspection. However, small grass was also growing through some of the joint areas.

## Downstream Slope

- The downstream slope was capped in concrete slabs with a consistent surface estimated at approximately 3 horizontal to 1 vertical (3H:1V) and was found in poor overall condition (See Photos 8-12).
- Some cracking with evidence of seepage emanating from cracks was noted close to the right end of the downstream slope (near the stilling basin).
- Concrete patches, which were noted near the top of the slope closest to the spillway, identified where grout was pumped under the slabs to fill voids.
- Sealant (which appeared relatively recent) was noted at all joints that in past inspections showed several large gaps.
- Weep holes at the base of the slope appeared to be clear of debris and sediment. The previous inspection noted that many of these were clogged. However, it was unclear if they were effective as no evidence of drainage was observed and seepage appeared from nearby cracks.
- Minor cracking was evident along many of the slabs but appeared to be natural weathering as opposed to a failure of the concrete slab.

## Spillway

- The spillway is located at the left end of the embankment and consists of a 160-ft wide weir wall, debris grates, bridge and concrete downslope and stilling basin. The overall structure and components were found in fair condition (See Photos 13-19).
- Some cracking and spalling was evident around the concrete bridge and slopes next to the spillway/bridge (this appeared about the same as noted during the last inspection).
- Sediment buildup (which was partially cleared out during the grouting project) was evident at the right end of the stilling basin. This is the same location where boils and sediment buildup were noted in previous inspections.

- At least one boil was identified in the same general location of the stilling basin as had been noted in past inspections. Mr. Harrison stated that there were now less boils than before the grouting project was completed.
- Heavy unwanted vegetation was noted to be growing around the stilling basin area.

## Emergency Spillway

- The concrete capped portion of the embankment is capable of handling flows over the crest and roadway and therefore functions as an emergency spillway at up to 900-ft long. The overall structure was found in fair condition (See Photos 20 and 21).
- The spillway portion of the roadway is estimated to be about 3 feet below the abutments (not protected with concrete) on each end.

## Low-Flow Outlet

- The low-flow inlet/outlet is located on the left end of the dam (marked by a warning sign) and consists of 24-in. steel pipe and valve at the downstream end. Mr. Harrison stated that the pipe and valve is used regularly (See Photos 22 and 23).
- Evidence of potential seepage at the low-flow outlet was noted during this inspection. This appeared to be similar to what was noted in the prior inspection. Overall the outlet appeared to be in working condition.

## Downstream Channel

The channel downstream of the spillway and stilling basin is a shallow wide floodplain type channel (Magnus Branch) with a relatively flat slope and heavily treed. The channel meanders in a southeastern direction before crossing US Highway 69 just over a mile downstream of the dam.

## OPERATION AND MAINTENANCE (O&M) PLAN

It is clear that maintenance is being performed. A written formal Operations and Maintenance Plan is in place for Lake Charmaine.

## EMERGENCY ACTION PLAN (EAP)

A draft Emergency Action Plan (EAP) was submitted to TCEQ Dam Safety for review on January 8, 2011. After a round of comments, a revised draft was submitted on April 1, 2014. Conflicting comments regarding some downstream hazards (4 residential structures near the dam abutments) have been issued from Dam Safety. The 2012 inspection report stated that houses located just downstream should not be included as hazards as they were at the same elevation as the top of dam. However, the April 24, 2014, comment letter stated those same structures should be included in the downstream inundation map as they were in the potential inundation zone. This was based on a simplified breach analysis that was conducted by dam safety staff. While the simplified breach methodology is conservative, we want to emphasize that the structures should be included in the EAP.

Lastly, we had information that a camp location was proposed to be located downstream from the dam. If this camp has been constructed it should also be included as a potential hazard in the EAP. A finalized draft is required to complete the EAP.

## POTENTIAL FAILURE MODES

Due to the potential piping condition occurring at the toe of the downstream slope of the dam, a significant storm event could raise the water level and head

pressure to accelerate any piping and cause a washout of the embankment material to such a degree that the concrete slabs could separate or fail and allow an uncontrolled loss of the reservoir.

## REQUIREMENTS/RECOMMENDATIONS

The following requirements and/or recommendations are provided:

- The persistent problem with sand boils and sediment accumulation requires a licensed Texas Professional Engineer with dam experience to diagnose the problem and develop a long-term solution. The development of any plans requires submission and approval through Dam Safety prior to commencement of any construction improvements.
- A finalized EAP draft should be submitted to the TCEQ Dam Safety Program. The draft should be based on current EAP guidelines and the most recent comment letter (dated April 24, 2014). The plan is required to be updated yearly. A current version of the guidance documents for an EAP may be found at the link listed below: https://www.tceq.texas.gov/compliance/investigation/damsafetyprog.html
- The following are recommendations for addressing the maintenance items noted during the inspection:
    a) Clear grass growing though open joints and reseal as needed.
    b) Remove silt from the stilling basin area and monitor the inflow of new silt and quantity and condition of boils as they re-appear. Locations of the boils should be recorded with dates and quantity of sediment removal.
    c) Heavy vegetation growing around the stilling basin area should be removed.
    d) Repair spalling, and seal minor cracks throughout the concrete slabs, particularly around the bridge and service spillway area.
    e) Monitor areas of seepage along the downstream concrete slabs and at the low-flow outlet. A log of seepage location and flow rates along with the lake level and date should be recorded and maintained.
    f) Monitor steel cable grates for damage, and repair if grates fail or become unserviceable due to damage from debris.
    g) Monitor weep holes for evidence of drainage to determine if they are effective in relieving pressure from behind the concrete slabs.

## CONCLUSION

The owner of this dam may be liable for downstream damages in the event of a spill or breach. It is the owner's responsibility to maintain the dam in a safe condition in order to prevent loss of life and limit the potential for property loss. In addition, regular maintenance may reduce future rehabilitation and repair costs. This structure will be scheduled for re-inspection in 2 years, or in conjunction with any modifications.

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Bill Sweeney, EIT
Dam Safety Section
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# Figure 1 – Location Map – Lake Charmaine Dam

# Figure 2–Aerial View (2016)
# Lake Charmaine Dam - 10' Contours

# Figure 3 – Lake Charmaine Dam
# Sketch and Photo Locations

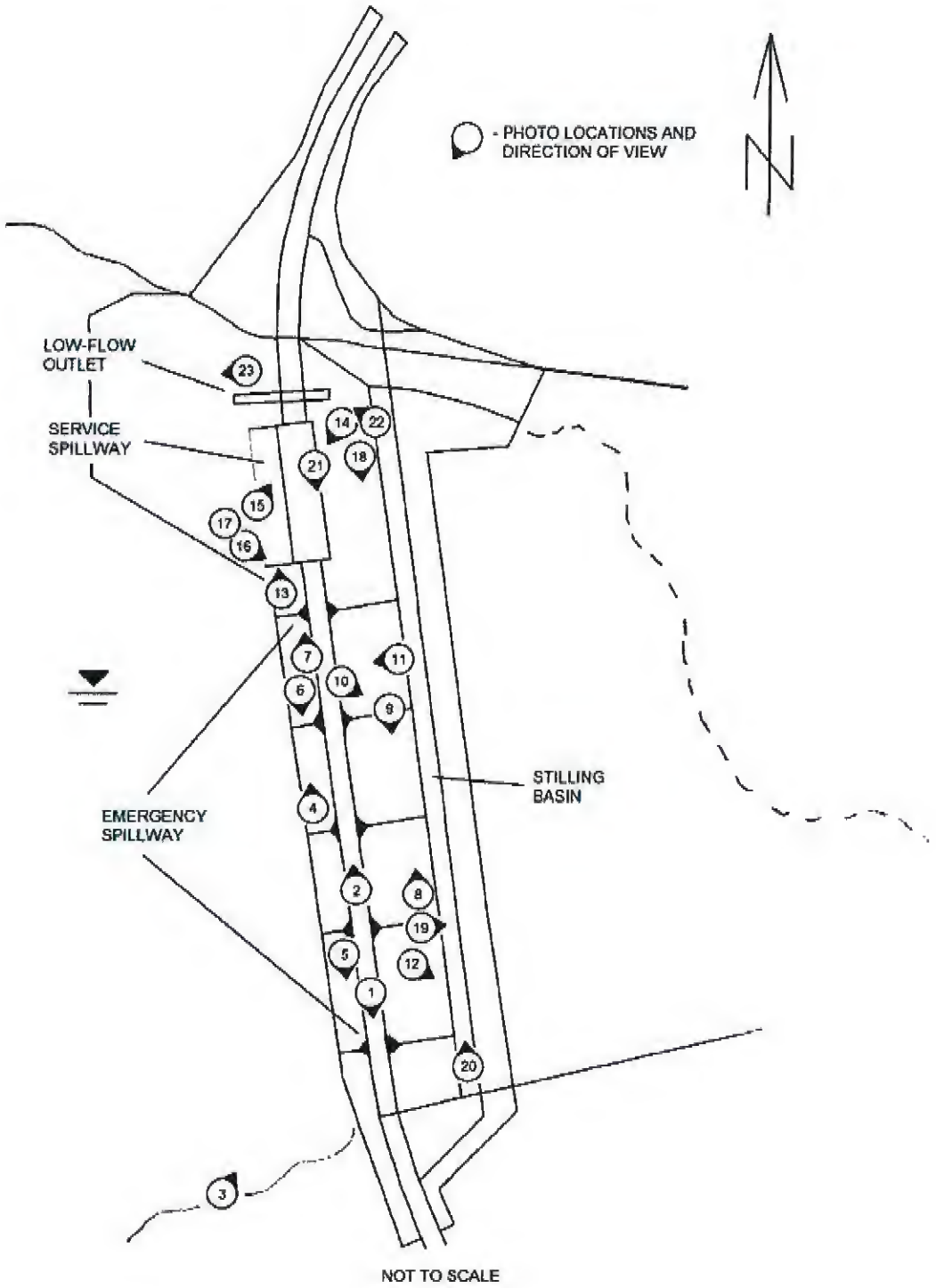

**Photo #1** – Crest of dam (roadway) approximately 24-ft wide looking south.

**Photo #2** – Crest of dam near the mid-point of the dam looking north. Crest was level with no dips or low spots.

**Photo #3** – Upstream slope of dam looking northeast.

**Photo #4** – Upstream slope of dam looking north. Note some grass growing through the joint (arrow) at the crest and upstream slope.

**Photo #5** – Upstream slope of dam looking south.

**Photo #6** – Close up view of upstream slope of dam looking south. Note the grass growing through at the joints.

**Photo #7** – Close up view of upstream slope of dam looking north. Note the joint between the crest and upstream slope has had sealant placed since the last inspection.

**Photo #8** – Downstream slope of the dam looking north. Note the consistent slope.

**Photo #9** – Downstream slope of the dam looking south.

**Photo #10** – View of dam's downstream slope. The square patch is one of the bore locations where grout was pumped into a void found under the slab.


**Photo #11** – View of dam's downstream slope near mid-point of dam looking west. Note the sealant at the joint in effort to prevent seepage under the slab. Additionally, the weepholes were found to be cleared of debris.

**Photo #12** – View of dam's downstream slope near the right end of dam looking southeast. Some seepage appeared to be occurring at this crack in the concrete slab. Areas of seepage in the slab were also noted in the previous inspection.

**Photo #13** – View of the dam's service spillway looking north. Note the spillway was engaged approximately 2-inches during the inspection.

**Photo #14** – View of the dam's service spillway looking southwest.

**Photo #15** – View of the dam's service spillway looking northeast. Note the wire grate at the spillway bridge. Also, some cracking (arrow) was observed at the bridge

**Photo #16** – View of cracking occurring in the concrete slab along the entrance to the spillway looking south.

**Photo #17** – View of cracking along the bridge at the spillway looking southeast.

**Photo #18** – View of the service spillway outlet and stilling basin looking southeast.

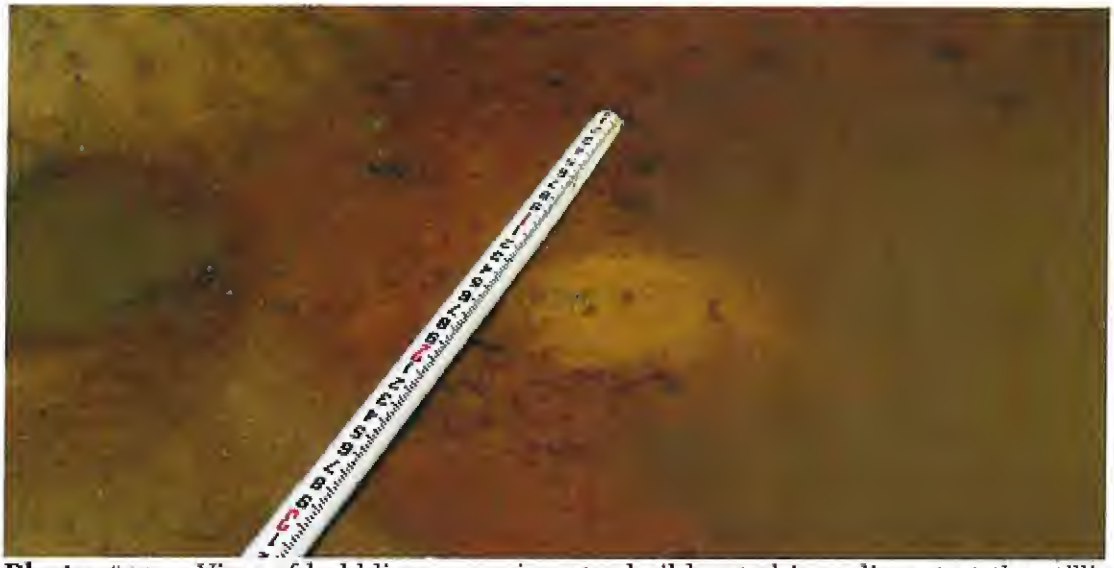

**Photo #19** – View of bubbling occurring at a boil located in sediment at the stilling basin just downstream of the concrete slope. Boils, which were noted during the last inspection, were also observed during this inspection. However, there did not appear to be as many or as large as noted in the previous inspection.

**Photo #20** – View of sediment buildup and grass in the stilling basin area looking north.

**Photo #21** – View of the dam's concrete embankment which functions as the emergency spillway during an extreme storm event.

**Photo #22** – View of the dam's low-flow outlet (24-inch outlet and valve) at the north end of the embankment looking northwest. Note some evidence of seepage below the outlet as also noted in previous inspection.


**Photo #23** – View of warning sign where the low flow inlet is located just next to the left side of the embankment looking west.